**Elite Mathematics**
Pearson Edexcel International GCSE

IGCSE LINEAR · 4MA1

# 4MA1/1HR May/November 2020 Worked Solutions

May/November 2020 paper rebuilt with the worked solution after each question.

| 23 | 2020–2026 | Single-paper solutions |
|---|---|---|
| paper questions | 52 past papers | checked by Dr Eslam |



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PAST PAPER

# 4MA1/1HR May/November 2020

May/November 2020

| 23 | 100 | 2 h |
| --- | --- | --- |
| questions | marks | exam time |

Each question is followed by its worked solution and final answer.

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# Question 1

3 marks | Fractions

**1** Show that $3\frac{3}{4} \times \frac{7}{9} = 2\frac{11}{12}$

**(Total for Question 1 is 3 marks)**

## WORKED SOLUTION

Question 1 · 4MA1/1HR May/November 2020

**1** **Simplify fraction**

$$3\frac{3}{4} = \frac{15}{4}$$

**2** **Simplify fraction**

Now multiply:

$$\frac{15}{4} \times \frac{7}{9}$$

**3** **Simplify fraction**

Cancel $15$ and $9$:

$$\frac{5}{4} \times \frac{7}{3} = \frac{35}{12}$$

$$\frac{35}{12} = 2\frac{11}{12}$$

✓ **FINAL ANSWER**

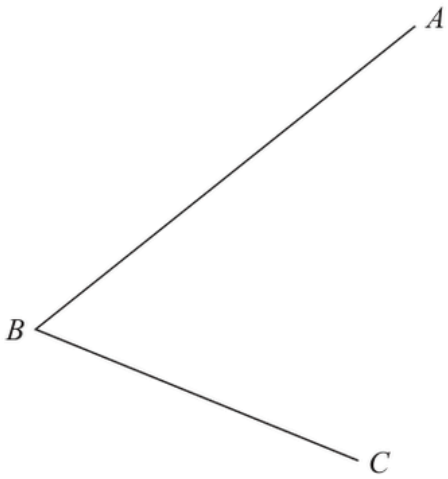
$2\frac{11}{12}$

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# Question 2

2 marks | Constructions & Loci

**2** Using ruler and compasses only, construct the bisector of angle $ABC$.
You must show all your construction lines.

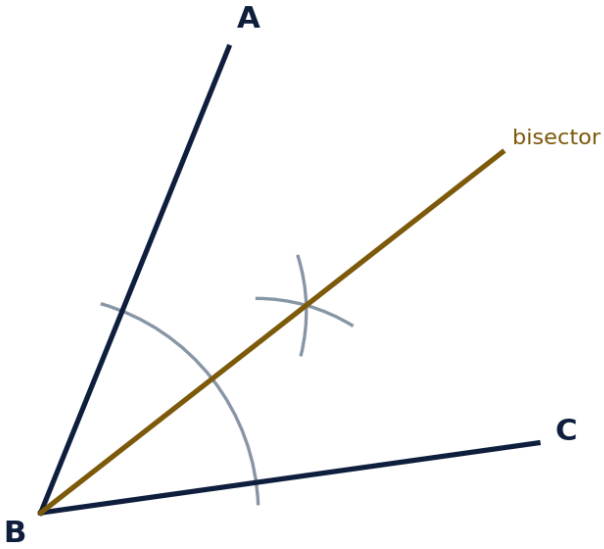



**(Total for Question 2 is 2 marks)**

## 1 Construction answer

To construct the bisector of angle $ABC$:

1. Put the compass point at $B$ and draw an arc cutting $BA$ and $BC$.
2. From those two cut points, draw equal arcs inside the angle.
3. Draw a straight line from $B$ through the point where the two arcs cross.




**FINAL ANSWER**

This line bisects angle $ABC$.

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# Question 3

6 marks | Linear Equations

**3** (a) Simplify $h^7 \times h^2$

.....

(1)

$G = c^2 - 4c$

(b) Find the value of $G$ when $c = -5$

$G =$ .....

(2)

(c) Solve $\dfrac{5x - 3}{4} = 2x + 3$

Show clear algebraic working.

$x =$ .....

(3)

**(Total for Question 3 is 6 marks)**

## WORKED SOLUTION

Question 3 · 4MA1/1HR May/November 2020

**1** **(a)**

(a)

$$h^7 \times h^2 = h^{7+2} = h^9$$

**2** **(b)**

(b)

$$G = c^2 - 4c$$

**3** **Solve quadratic equation**

When $c = -5$:

$$G = (-5)^2 - 4(-5) = 25 + 20 = 45$$

**4** **(c)**

(c)

$$\frac{5x-3}{4}=2x+3$$

---

**5** **Multiply by 4**

Multiply by 4:

$$5x-3=8x+12$$

$$-3x=15$$

$$x=-5$$

---

✓ **FINAL ANSWER**

$h^9$, $G=45$, and $x=-5$.

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# Question 4

5 marks | Averages from Frequency Tables

**4** The table gives information about the length of time, in minutes, that each of 60 students took to travel to school on Monday.

| Length of time ($t$ minutes) | Frequency |
|---|---|
| $0 < t \leqslant 10$ | 4 |
| $10 < t \leqslant 20$ | 10 |
| $20 < t \leqslant 30$ | 15 |
| $30 < t \leqslant 40$ | 25 |
| $40 < t \leqslant 50$ | 6 |

(a) Write down the modal class interval.

.....

**(1)**

(b) Work out an estimate for the mean length of time taken by these 60 students to travel to school on Monday.
Give your answer correct to one decimal place.

..... minutes

**(4)**

**(Total for Question 4 is 5 marks)**

## WORKED SOLUTION

Question 4 · 4MA1/1HR May/November 2020

**1** **The modal class is the**

The modal class is the class with the greatest frequency:

$$30 < t \leq 40$$

**2** **Use midpoints**

Use midpoints $5, 15, 25, 35, 45$.

$$5(4) + 15(10) + 25(15) + 35(25) + 45(6) = 1690$$

$$\text{estimated mean} = \frac{1690}{60} = 28.166\ldots$$

---

✓ **FINAL ANSWER**

modal class $30 < t \leq 40$, estimated mean $28.2$ minutes.

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# Question 5

6 marks | Reverse Percentages

5 In 2017, the population of a village was 7500
In 2019, the population of the village was 8265

(a) Work out the percentage increase in the population of the village from 2017 to 2019

..... %

(3)

In a sale, normal prices are reduced by 30%
The sale price of a T-shirt was 31.50 euros.

(b) Work out the normal price of the T-shirt.

..... euros

(3)

**(Total for Question 5 is 6 marks)**

## WORKED SOLUTION

Question 5 · 4MA1/1HR May/November 2020

### 1 The population increase is

The population increase is

$$8265 - 7500 = 765$$

### 2 Percentage increase

Percentage increase:

$$\frac{765}{7500} \times 100 = 10.2\%$$

### 3 The T shirt sale price

The T-shirt sale price is after a $30\%$ reduction, so it is $70\%$ of the normal price.

$$0.70 \times \text{normal price} = 31.50$$

$$\text{normal price} = 31.50 \div 0.70 = 45$$

**FINAL ANSWER**

(a) $10.2\%$, (b) $45$ euros.

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# Question 6

2 marks | Linear Graphs

6 Point $A$ has coordinates $(-3, 11)$
Point $B$ has coordinates $(47, b)$
The midpoint of $AB$ has coordinates $(a, -19)$

Find the value of $a$ and the value of $b$.

$a =$ .....

$b =$ .....

**(Total for Question 6 is 2 marks)**

## WORKED SOLUTION

Question 6 · 4MA1/1HR May/November 2020

**1 Calculate value**

$$A = (3, 11), \qquad B = (47, b)$$

**2 The midpoint is**

The midpoint is $(a, 19)$.

**3 Evaluate fraction**

For the x-coordinate:

$$a = \frac{3 + 47}{2} = 25$$

**4 Evaluate fraction**

For the y-coordinate:

$$19 = \frac{11 + b}{2}$$

$$38 = 11 + b$$

$$b = 27$$

**FINAL ANSWER**

$a = 25, b = 27$.

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# Question 7

4 marks | Standard & Compound Units

7 Pedro drove from Toulouse to Montpellier in 2 hours 42 minutes.
He drove at an average speed of 90 km/hour.

Janine drove from Toulouse to Montpellier along the same route as Pedro.
The journey took her 3 hours.

Work out Janine's average speed for the journey.

..... km/hour

**(Total for Question 7 is 4 marks)**

## WORKED SOLUTION

Question 7 · 4MA1/1HR May/November 2020

### 1 Pedro s time was

Pedro's time was

$$2\text{ h }42\text{ min} = 2.7\text{ h}$$

### 2 Distance from Toulouse to Montpellier

Distance from Toulouse to Montpellier:

$$90 \times 2.7 = 243\text{ km}$$

### 3 Calculate value

Janine took 3 hours, so her average speed was

$$243 \div 3 = 81$$

**FINAL ANSWER**

$81\text{ km/hour}$.

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# Question 8

3 marks | Compound Interest & Depreciation

8 Harold bought an antique clock for £1200
The clock increased in value by 8% per year.

Find the value of the clock exactly 3 years after Harold bought the clock.
Give your answer correct to the nearest £.

£.....

(Total for Question 8 is 3 marks)

## WORKED SOLUTION

Question 8 · 4MA1/1HR May/November 2020

### 1 The multiplier for an increase

The multiplier for an $8\%$ increase is

$$1.08$$

### 2 Value after 3 years

Value after 3 years:

$$1200(1.08)^3 = 1511.6544$$

### 3 Use compound interest

Correct to the nearest pound,

$$1511.6544 \approx 1512$$

**FINAL ANSWER**

$1512$ pounds

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# Question 9

3 marks | Standard & Compound Units

9 A box is put on a horizontal table.

The face of the box in contact with the table is a square of side 1.5 metres.
The pressure on the table due to the box is 34.8 newtons/m$^2$

Work out the force exerted by the box on the table.

$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

..... newtons

**(Total for Question 9 is 3 marks)**

## WORKED SOLUTION

Question 9 · 4MA1/1HR May/November 2020

### 1 The area of the square

The area of the square face is

$$1.5 \times 1.5 = 2.25 \text{ m}^2$$

### 2 Use

Use

$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

### 3 Calculate area

So

$$\text{force} = \text{pressure} \times \text{area}$$

$$34.8 \times 2.25 = 78.3$$

**FINAL ANSWER**

78.3 newtons.

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# Question 10

5 marks | Reverse Percentages

**10** Alex makes 80 cakes to sell.
He makes chocolate cakes, lemon cakes and fruit cakes where

$$\text{number of chocolate cakes} : \text{number of lemon cakes} : \text{number of fruit cakes} = 3 : 2 : 5$$

Alex sells

all of the chocolate cakes

$\frac{3}{4}$ of the lemon cakes

$\frac{7}{8}$ of the fruit cakes

The profit he makes on each cake he sells is shown in the table.

| Type of cake | Profit per cake he sells |
|---|---|
| chocolate | £2.00 |
| lemon | £1.70 |
| fruit | £2.40 |

Work out the total profit that Alex makes from the cakes he sells.

£.....

**(Total for Question 10 is 5 marks)**

## WORKED SOLUTION

Question 10 · 4MA1/1HR May/November 2020

### 1 The ratio parts are

The ratio parts are

$$3 + 2 + 5 = 10$$

## 2 Numbers of cakes made

Numbers of cakes made:

$$\text{chocolate} = 80 \times \frac{3}{10} = 24$$

$$\text{lemon} = 80 \times \frac{2}{10} = 16$$

$$\text{fruit} = 80 \times \frac{5}{10} = 40$$

## 3 Cakes sold

Cakes sold:

$$\text{chocolate} = 24, \quad \text{lemon} = \frac{3}{4} \times 16 = 12, \quad \text{fruit} = \frac{7}{8} \times 40 = 35$$

## 4 Total profit

Total profit:

$$24(2.00) + 12(1.70) + 35(2.40) = 48 + 20.40 + 84 = 152.40$$

**FINAL ANSWER**

$152.40$ pounds

# Question 11

5 marks | Cumulative Frequency Diagrams

**11** The frequency table gives information about the ages of the 80 people in a train carriage.

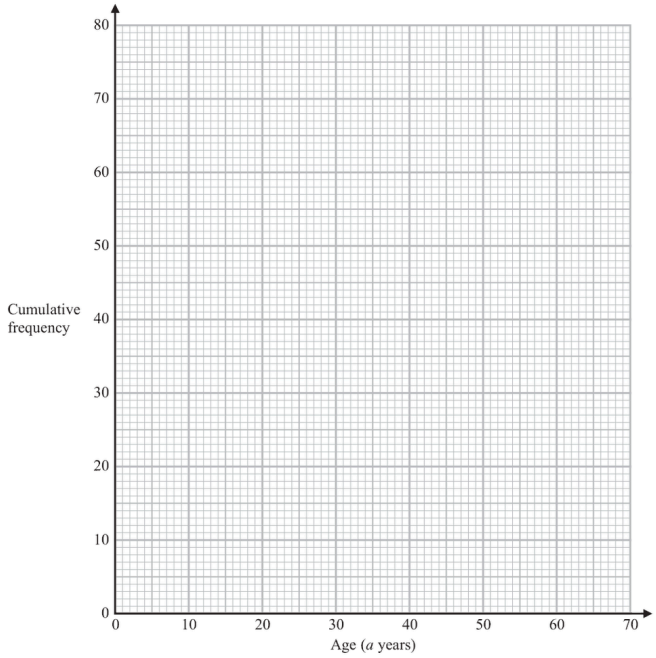
| Age ($a$ years) | Frequency |
|---|---|
| $0 < a \leqslant 20$ | 9 |
| $20 < a \leqslant 30$ | 19 |
| $30 < a \leqslant 40$ | 17 |
| $40 < a \leqslant 50$ | 18 |
| $50 < a \leqslant 60$ | 13 |
| $60 < a \leqslant 70$ | 4 |

(a) Complete the cumulative frequency table.

| Age ($a$ years) | Cumulative frequency |
|---|---|
| $0 < a \leqslant 20$ | |
| $0 < a \leqslant 30$ | |
| $0 < a \leqslant 40$ | |
| $0 < a \leqslant 50$ | |
| $0 < a \leqslant 60$ | |
| $0 < a \leqslant 70$ | |

(1)

(b) On the grid, draw a cumulative frequency graph for your table.




(2)

(c) Use your graph to find an estimate for the median age of the people in the train carriage.

..... years

(2)

**(Total for Question 11 is 5 marks)**

1

### (a) Running totals

$$9,\ 28,\ 45,\ 63,\ 76,\ 80$$

2

### (b) Plot at the upper class boundaries

Plot $(20, 9), (30, 28), (40, 45), (50, 63), (60, 76), (70, 80)$, start at $(0, 0)$, and join with a smooth curve.

3

### (c) Median

Read across from $\frac{80}{2} = 40$: about $37$ years.

✓ **FINAL ANSWER**

(a) $9, 28, 45, 63, 76, 80$ (c) about $37$ years

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# Question 12

4 marks | Simultaneous Equations

**12** Solve the simultaneous equations

$$7x + 2y = 5.5$$
$$3x - 5y = 17$$

Show clear algebraic working.

$x =$ .....

$y =$ .....

**(Total for Question 12 is 4 marks)**

## WORKED SOLUTION

Question 12 · 4MA1/1HR May/November 2020

**1 Solve simultaneous equations**

$$7x + 2y = 5.5$$

$$3x - 5y = 17$$

**2 Multiply the first equation by**

Multiply the first equation by 5:

$$35x + 10y = 27.5$$

**3 Multiply the second equation by**

Multiply the second equation by 2:

$$6x - 10y = 34$$

**4 Add**

Add:

$$41x = 61.5$$

$$x = 1.5$$

**5** **Solve simultaneous equations**

Substitute into $7x + 2y = 5.5$:

$$10.5 + 2y = 5.5$$

$$y = -2.5$$

---

**FINAL ANSWER**

$x = 1.5$, $y = -2.5$.

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# Question 13

6 marks | Differentiation & Turning Points

**13** The curve **C** has equation $y = 5x^3 - x^2 - 6x + 4$

(a) Find $\frac{dy}{dx}$

$\frac{dy}{dx} =$ .....

(2)

There are two points on the curve **C** at which the gradient of the curve is 2

(b) Find the $x$ coordinate of each of these two points.
Show clear algebraic working.

.....

(4)

**(Total for Question 13 is 6 marks)**

## WORKED SOLUTION

Question 13 · 4MA1/1HR May/November 2020

**1** **Find the gradient**

$$y = 5x^3 - x^2 - 6x + 4$$

$$\frac{dy}{dx} = 15x^2 - 2x - 6$$

**2** **Find the gradient**

The gradient is 2, so

$$15x^2 - 2x - 6 = 2$$

$$15x^2 - 2x - 8 = 0$$

$$x = \frac{2 \pm \sqrt{(-2)^2 - 4(15)(-8)}}{30}$$

$$x = \frac{2 \pm 22}{30}$$

$$x = \frac{4}{5} \quad \text{or} \quad x = -\frac{2}{3}$$

---

**FINAL ANSWER**

$x = -\frac{2}{3}$ and $x = \frac{4}{5}$.

4MA1/1HR MAY/NOVEMBER 2020

# Question 14

3 marks | Expanding Brackets

**14** Expand and simplify $(4x + 1)(x - 3)(5x + 6)$

**(Total for Question 14 is 3 marks)**

## WORKED SOLUTION

Question 14 · 4MA1/1HR May/November 2020

### 1 Expand brackets

$$(4x + 1)(x - 3)(5x + 6)$$

$$(x - 3)(5x + 6) = 5x^2 - 9x - 18$$

$$(4x + 1)(5x^2 - 9x - 18) = 20x^3 - 31x^2 - 81x - 18$$

**FINAL ANSWER**

$20x^3 - 31x^2 - 81x - 18$

# Question 15

4 marks | Circle Theorems

**15**

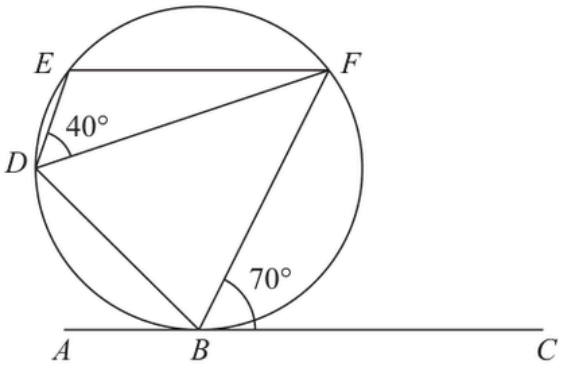



Diagram **NOT** accurately drawn

$B$, $D$, $E$ and $F$ are points on a circle.
$ABC$ is the tangent to the circle at $B$.

Angle $EDF = 40°$
Angle $FBC = 70°$

Prove that the tangent $ABC$ is parallel to $EF$.
Give a reason for each stage of your working.

**(Total for Question 15 is 4 marks)**

## 1 Proof

By the alternate segment theorem, the angle between tangent $BC$ and chord $BF$ equals the angle in the opposite segment:

$$\angle BEF = 70°$$

Given

$$\angle EDF = 40°$$

Angles $EDF$ and $EBF$ stand on the same chord $EF$, so

$$\angle EBF = 40°$$

In triangle $BEF$,

$$\angle EFB = 180° - 70° - 40° = 70°$$

So

$$\angle EFB = \angle FBC = 70°$$

These are alternate interior angles, so

$$EF \parallel ABC$$

**FINAL ANSWER**

The tangent $ABC$ is parallel to $EF$.

4MA1/1HR MAY/NOVEMBER 2020

# Question 16

9 marks | Functions

**16** The functions f and g are defined as

$$f: x \mapsto 5x - 7$$

$$g: x \mapsto \frac{5x}{x+4}$$

(a) Write down the value of $x$ that must be excluded from any domain of g

.....

(1)

(b) Find gf(2.6)

.....

(2)

(c) Solve $fg(x) = 2$

$x =$ .....

(3)

(d) Express the inverse function $g^{-1}$ in the form $g^{-1}: x \mapsto ...$

$g^{-1}: x \mapsto$ .....

(3)

**(Total for Question 16 is 9 marks)**

## WORKED SOLUTION

Question 16 · 4MA1/1HR May/November 2020

**1** **Evaluate fraction**

$$f(x) = 5x - 7, \qquad g(x) = \frac{5x}{x+4}$$

**2** **(a) The denominator of cannot**

(a) The denominator of $g$ cannot be zero, so

$$x = -4$$

**3** **(b)**

(b)

$$f(2.6) = 5(2.6) - 7 = 6$$

$$gf(2.6) = g(6) = \frac{5(6)}{6+4} = 3$$

---

**4** **(c)**

(c)

$$fg(x) = 2$$

$$f(g(x)) = 2$$

$$5g(x) - 7 = 2$$

$$g(x) = \frac{9}{5}$$

$$\frac{5x}{x+4} = \frac{9}{5}$$

$$25x = 9x + 36$$

$$16x = 36$$

$$x = \frac{9}{4}$$

---

**5** **(d) Let**

(d) Let

$$y = \frac{5x}{x+4}$$

$$y(x+4) = 5x$$

$$yx + 4y = 5x$$

$$x(y-5) = -4y$$

$$x = \frac{4y}{5-y}$$

**6** **Evaluate fraction**

So

$$g^{-1}(x) = \frac{4x}{5-x}$$

**FINAL ANSWER**

$-4$, $3$, $x = \frac{9}{4}$, and $g^{-1}(x) = \frac{4x}{5-x}$.

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# Question 17

6 marks | 3D Pythagoras & Trigonometry

**17** The diagram shows a prism $ABCDEFGH$ with a horizontal base.

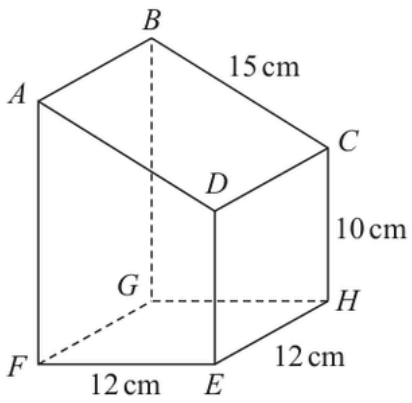



Diagram **NOT** accurately drawn

The base of the prism, $EFGH$, is a square of side 12 cm.
Trapezium $ADEF$ is a cross section of the prism where $AF$ and $DE$ are vertical edges.

$DE = CH = 10$ cm
$AD = BC = 15$ cm

(a) Work out the size of the angle between $CF$ and the base $EFGH$.
Give your answer correct to one decimal place.

..... °

(3)

(b) Work out the length of $BE$.
Give your answer correct to one decimal place.

..... cm

(3)

**(Total for Question 17 is 6 marks)**

## WORKED SOLUTION

Question 17 · 4MA1/1HR May/November 2020

**1** **Use trigonometry**

(a) $C$ is vertically above $H$, so the vertical height from $F$ to $C$ is $10$ cm.

2 **The projection of on the**

The projection of $CF$ on the base is $FH$:

$$FH = 12\sqrt{2}$$

$$\tan\theta = \frac{10}{12\sqrt{2}}$$

$$\theta = 30.508\ldots^\circ$$

---

3 **Answer**

**Answer:** $30.5^\circ$.

---

4 **(b) In the trapezium cross**

(b) In the trapezium cross-section, $AD = 15$ and the horizontal distance is $12$, so the difference in vertical heights is

$$\sqrt{15^2 - 12^2} = 9$$

---

5 **Use trigonometry**

Since $DE = 10$, the height $BG = 19\ \text{cm}$.

---

6 **The projection of on the**

The projection of $BE$ on the base is $GE = 12\sqrt{2}$, so

$$BE = \sqrt{19^2 + (12\sqrt{2})^2} = 25.475\ldots$$

---

✓ **FINAL ANSWER**

$25.5\ \text{cm}$.

4MA1/1HR MAY/NOVEMBER 2020

# Question 18

4 marks | Sequences

**18** In an arithmetic series, the 6th term is 39
In the same arithmetic series, the 19th term is 7.8

Work out the sum of the first 25 terms of the arithmetic series.

**(Total for Question 18 is 4 marks)**

## WORKED SOLUTION

Question 18 · 4MA1/1HR May/November 2020

**1 Let the first term be**

Let the first term be $a$ and the common difference be $d$.

**2 The 6th term is 39**

The 6th term is 39:

$$a + 5d = 39$$

**3 Find the nth term**

The 19th term is 7.8:

$$a + 18d = 7.8$$

**4 Subtract**

Subtract:

$$13d = -31.2$$

$$d = -2.4$$

**5 Find the nth term**

Then

$$a + 5(-2.4) = 39$$

$$a = 51$$

**6** **The sum of the first**

The sum of the first 25 terms is

$$S_{25} = \frac{25}{2}(2a + 24d)$$

$$S_{25} = \frac{25}{2}(102 - 57.6) = 555$$

---

✓ **FINAL ANSWER**

$555$.

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# Question 19

3 marks | Rounding, Estimation & Bounds

**19** The diagram shows rectangle $ABCD$ with rectangle $EFGH$ cut out to form the shaded region.

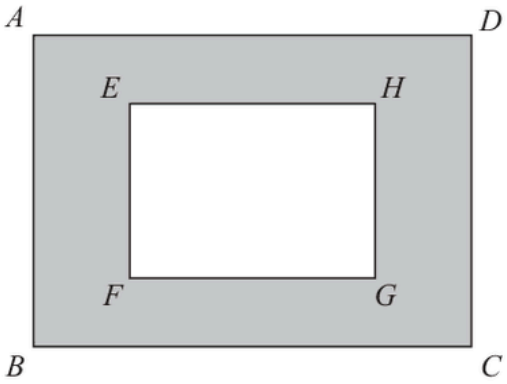



Diagram **NOT** accurately drawn

$AD = 8.3$ cm correct to one decimal place
$DC = 7.2$ cm correct to one decimal place
$EH = 6.2$ cm correct to one decimal place
$HG = 5.3$ cm correct to one decimal place

Work out the upper bound of the area of the shaded region.
Show your working clearly.

..... cm²

**(Total for Question 19 is 3 marks)**

## WORKED SOLUTION

Question 19 · 4MA1/1HR May/November 2020

**1** **Find upper bound**

For the upper bound of the shaded area, use the upper bound of the outer rectangle and subtract the lower bound of the cut-out rectangle.

**2** **Outer rectangle**

Outer rectangle:

$$AD < 8.35, \quad DC < 7.25$$

### 3 Cut out rectangle

Cut-out rectangle:

$$EH \geq 6.15, \quad HG \geq 5.25$$

$$\text{upper shaded area} = 8.35(7.25) - 6.15(5.25)$$

$$= 60.5375 - 32.2875 = 28.25$$

---

**FINAL ANSWER**

$28.25\ \text{cm}^2$

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# Question 20

2 marks | Transformations of Graphs

**20** A curve has equation $y = f(x)$
There is only one maximum point on the curve.
The coordinates of this maximum point are $(-3, 4)$

Write down the coordinates of the maximum point on the curve with equation

(i) $y = f(x) - 6$

(.....  , .....)

(ii) $y = f(2x)$

(.....  , .....)

**(Total for Question 20 is 2 marks)**

## WORKED SOLUTION

Question 20 · 4MA1/1HR May/November 2020

**1 The maximum point of is**

The maximum point of $y = f(x)$ is $(-3, 4)$.

**2 Calculate value**

For

$$y = f(x) - 6$$

**3 the graph moves 6 units**

the graph moves 6 units down:

$$(-3, 4) \rightarrow (-3, -2)$$

**4 Calculate value**

For

$$y = f(2x)$$

**5 the coordinate is divided by**

the $x$-coordinate is divided by 2:

$$(-3, 4) \rightarrow \left(-\frac{3}{2}, 4\right)$$

**FINAL ANSWER**

$(-3, -2)$ and $\left(-\frac{3}{2}, 4\right)$

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# Question 21

5 marks | Algebraic Roots & Indices

**21** Given that $M = \dfrac{18^{4n} \times 2^{3(n^2-6n)} \times 3^{2(1-4n)}}{12^2}$

find the values of $n$ for which $M = 2$

**(Total for Question 21 is 5 marks)**

## WORKED SOLUTION

Question 21 · 4MA1/1HR May/November 2020

**1** **Use index laws**

$$18^{4n} = (2 \times 3^2)^{4n} = 2^{4n}3^{8n}$$

$$12^2 = (2^2 \times 3)^2 = 2^4 3^2$$

**2** **Use index laws**

So

$$M = \frac{2^{4n}3^{8n} \times 2^{3(n^2-6n)} \times 3^{2(1-4n)}}{2^4 3^2}$$

**3** **Combine powers of 2**

Combine powers of 2:

$$2^{4n+3n^2-18n-4} = 2^{3n^2-14n-4}$$

**4** **Combine powers of 3**

Combine powers of 3:

$$3^{8n+2-8n-2} = 3^0 = 1$$

**5** **Use index laws**

So

$$M = 2^{3n^2-14n-4}$$

**6** **Use index laws**

Given $M = 2$,

$$3n^2 - 14n - 4 = 1$$

$$3n^2 - 14n - 5 = 0$$

$$(3n + 1)(n - 5) = 0$$

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✓ **FINAL ANSWER**

$n = -\frac{1}{3}$ or $n = 5$

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# Question 22

6 marks | Perimeter & Area

**22** The diagram shows a regular octagon *ABCDEFGH*.

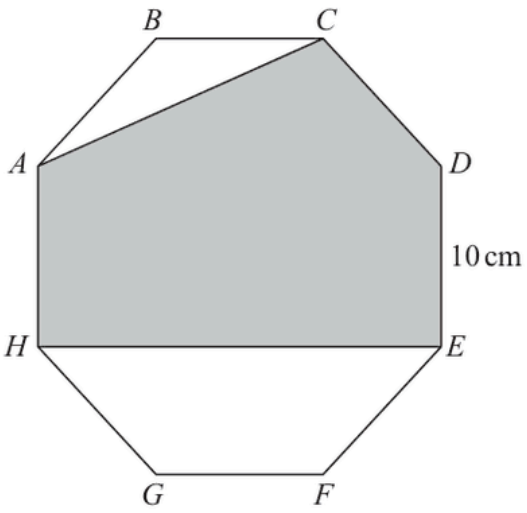



Diagram **NOT** accurately drawn

Each side of the octagon has length 10 cm.

Find the area of the shaded region *ACDEH*.
Give your answer correct to the nearest $cm^2$

..... $cm^2$

**(Total for Question 22 is 6 marks)**

## WORKED SOLUTION

Question 22 · 4MA1/1HR May/November 2020

**1** **Each side of the regular**

Each side of the regular octagon is $10$ cm.

**2** **Calculate area**

For a regular octagon with side length $s$,

$$\text{area} = 2(1+\sqrt{2})s^2$$

**3** **Calculate area**

So the area of the whole octagon is

$$2(1+\sqrt{2})(10)^2 = 200 + 200\sqrt{2}$$

**4** **The unshaded triangle has**

The unshaded triangle $ABC$ has

$$AB = 10, \qquad BC = 10, \qquad \angle ABC = 135^\circ$$

**5** **Use trigonometry**

So

$$\text{area of triangle } ABC = \frac{1}{2}(10)(10)\sin 135^\circ = 25\sqrt{2}$$

**6** **Find the gradient**

At the bottom, the unshaded trapezium $HEFG$ has parallel sides

$$HE = 10 + 10\sqrt{2}, \qquad GF = 10$$

**7** **Simplify surd**

and height

$$5\sqrt{2}$$

**8** **Calculate area**

So

$$\text{area of trapezium } HEFG = \frac{1}{2}(10 + 10 + 10\sqrt{2})(5\sqrt{2})$$

$$= 50 + 50\sqrt{2}$$

**9** **The shaded area is**

The shaded area is

$$(200 + 200\sqrt{2}) - 25\sqrt{2} - (50 + 50\sqrt{2})$$

$$= 150 + 125\sqrt{2}$$

$$= 326.7766\ldots$$

**FINAL ANSWER**

$\boxed{327\ \text{cm}^2}$

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# Question 23

4 marks | Probability Toolkit

**23** In a bag, there are only

3 blue beads
4 white beads
and $x$ orange beads.

Jean is going to take at random two beads from the bag.

The probability that Jean will take two beads of the same colour is $\frac{3}{8}$

Find the total number of beads in the bag.
Show clear algebraic working.

**(Total for Question 23 is 4 marks)**

## WORKED SOLUTION

Question 23 · 4MA1/1HR May/November 2020

### 1 The total number of beads

The total number of beads is

$$x + 7$$

### 2 The probability of choosing two

The probability of choosing two beads of the same colour is

$$\frac{\binom{3}{2} + \binom{4}{2} + \binom{x}{2}}{\binom{x+7}{2}}$$

**3** **Evaluate fraction**

This is equal to $\frac{3}{8}$, so

$$\frac{3+6+\frac{x(x-1)}{2}}{\frac{(x+7)(x+6)}{2}}=\frac{3}{8}$$

$$\frac{x^2-x+18}{(x+7)(x+6)}=\frac{3}{8}$$

$$8(x^2-x+18)=3(x+7)(x+6)$$

$$8x^2-8x+144=3x^2+39x+126$$

$$5x^2-47x+18=0$$

$$(x-9)(5x-2)=0$$

**4** **Calculate value**

Since $x$ must be a whole number,

$$x=9$$

**5** **Calculate value**

So the total number of beads is

$$9+7=16$$

**FINAL ANSWER**

$16$ beads